

Bacteriological Study of Paronychia in Military Personnel

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= Abstract =

Background: Paronychia is a common infectious disease affecting fingernails and toenails. Although bacterial and fungal infections as well as mechanical trauma may play roles in the pathogenesis of this disease, there are few bacteriological studies about paronychia in military personnel.

Objective: To identify the causative bacteria of paronychia in military personnel.

Methods: We retrospectively analyzed the microbiological results of 145 patients who visited a tertiary referral hospital for Korean soldiers from August 2004 to October 2006.

Results: Twenty-eight different types of aerobic bacteria were identified, with the most common being *Staphylococcus aureus* (38.0%), *Streptococcus pyogenes* (7.2%), and *Pseudomonas aeruginosa* (5.4%). *Staphylococcus aureus* was identified mostly in finger and toe paronychia lesions and *Pseudomonas aeruginosa* was recovered commonly from toe paronychia lesions. All cases of paronychia were controlled by the combination of antiseptic dressing, topical antibacterial ointment, oral antibiotics, and antimycotic agents.

Conclusion: The types of bacteria that most commonly caused paronychia in military personnel were *Staphylococcus aureus*, *Streptococcus pyogenes*, and *Pseudomonas aeruginosa*. Thus, the commonly used oral antibiotics for paronychia, such as amoxicillin-clavulanate, clindamycin, and trimethoprim-sulfamethoxazole, are good choices in the treatment of paronychia in military personnel.

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INTRODUCTION

Paronychia is an inflammatory reaction involving the folds of tissue surrounding a fingernail or toenail. Acute paronychia can be induced by species of *Staphylococcus*, *Streptococcus*, and

Pseudomonas. *Candida albicans* has also frequently been found in chronic paronychia lesions¹. Military recruits are mostly young males, and they are exposed to many opportunities for trauma near their fingernails and toenails during combat training and outdoor exercise. Trauma can induce the entry of pathogenic bacteria in the area around nails.

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Fig. 1. Finger paronychia associated with *Pseudomonas aeruginosa*.



Fig. 2. Toe paronychia associated with *Staphylococcus aureus*.

Furthermore, most military personnel wear military footwear and gloves for long periods of time. This leads to the microenvironment surrounding the feet and hands being very warm and moist, which in turn leads to military personnel having an increased susceptibility to various infectious diseases. For these reasons, paronychia is quite common in military recruits. However, the bacteriological profile of paronychia in military personnel is not well known, as past reports on the bacteriological profile of paronychia were conducted in small numbers of either children or non-military adults. Therefore, we investigated the causative organisms of paronychia in military personnel.

METHODS AND MATERIALS

We retrospectively reviewed the charts of all 145 patients who were treated for paronychia at the Armed Forces Capital Hospital in Gyeonggi-do, Korea, the tertiary referral hospital for Korean soldiers, from August 2004 to October 2006. During that period, specimens were collected from the infected area through pus aspiration or the swabbing of the paronychia lesion. The obtained specimens were grown in culture aerobically. Specimens were transferred to the microbiology laboratory and cultured on sheep-blood, chocolate,

and MacConkey's agar plates. The culture plates were incubated at 37°C in the presence of 5% CO₂ for 24~48 h. The identification of the bacteria that grew on the agar plates was done through the necessary biological tests. Information collected from the patients' charts included patient age, sex, and the site of the paronychia lesion(s). All patients involved in this study were followed up until the lesion was completely healed.

RESULTS

A total of 145 male patients with a mean age of 23.2 years were diagnosed with paronychia from August 2004 to October 2006. Thirty-four patients had paronychia on toes, whereas 111 had paronychia that involved their fingers. The thumb and the second finger were the most common sites of finger paronychia, and the great toe was the most common site for paronychia that involved a toe. Paronychia lesions showed periungual erythema, inflammation, granulation, and in some cases, a greenish discoloration of nails (Figs. 1, 2).

Organisms were found in all of the specimens studied, and a total of 28 different types of bacteria were recovered in the specimens from the 145 patients (Table 1). The most commonly identified bacteria was *Staphylococcus aureus* (63/

Table 1. The organisms isolated from 145 patients with paronychia

Bacteria	Total, n	Finger, n	Toe, n
Gram positive			
Coagulase negative staphylococcus	18	14	4
<i>Enterococcus gallinarum</i>	1	1	0
<i>Kocuria kristinae</i>	1	1	0
<i>Kocuria rosea</i>	2	0	2
<i>Staphylococcus aureus</i>	63	52	11
<i>Staphylococcus auricularis</i>	3	3	0
<i>Staphylococcus capitis</i>	2	2	0
<i>Staphylococcus cohnii</i>	1	1	0
<i>Staphylococcus epidermidis</i>	15	15	0
<i>Staphylococcus haemolyticus</i>	2	2	0
<i>Staphylococcus intermedius</i>	3	3	0
<i>Staphylococcus lentus</i>	3	3	0
<i>Staphylococcus lugdunensis</i>	4	3	1
<i>Staphylococcus saprophyticus</i>	1	1	0
<i>Staphylococcus simulans</i>	1	0	1
<i>Staphylococcus warneri</i>	2	2	0
<i>Staphylococcus xylosus</i>	2	1	1
<i>Streptococcus dysgalactiae</i>	1	1	0
<i>Streptococcus pyogenes</i>	12	12	0
Other gram positive cocci	4	0	4
Gram negative			
<i>Acinetobacter baumannii</i>	1	0	1
<i>Citrobacter freundii</i>	1	1	0
<i>Enterobacter aerogenes</i>	2	0	2
<i>Enterobacter cloacae</i>	1	0	1
<i>Klebsiella pneumonia</i>	1	0	1
<i>Morganella morganii</i>	3	0	3
<i>Providencia stuartii</i>	1	0	1
<i>Pseudomonas aeruginosa</i>	9	1	8
<i>Serratia marcescens</i>	4	0	4
Other gram negative bacilli	1	0	1
Other gram negative cocci	1	0	1
Total	166	119	47

Table 2. Frequency of the three most common types of causative bacteria cultured from paronychial lesions

Organism	Finger, n	Toe, n	Total, n (%)
<i>Staphylococcus aureus</i>	52	11	63 (38.0%)
<i>Streptococcus pyogenes</i>	12	0	13 (7.2%)
<i>Pseudomonas aeruginosa</i>	1	8	9 (5.4%)
Total	65	19	85

166, 38.0%). Other commonly recovered bacteria were *Staphylococcus epidermidis* (15/166, 9.0%), *Streptococcus pyogenes* (12/146, 7.2%), and *Pseudomonas aeruginosa* (9/166, 5.4%). Of the specimens collected from patients with paronychial lesions on a toe, the most commonly identified bacteria were *Staphylococcus aureus* (11/47, 23.4%) and *Pseudomonas aeruginosa* (8/47, 17.0%), whereas the most commonly identified bacteria in finger paronychial lesions were *Staphylococcus aureus* (52/119, 43.7%), *Staphylococcus epidermidis* (15/119, 12.6%), and *Streptococcus pyogenes* (12/119, 10.1%). *Pseudomonas aeruginosa* was found in only one case of finger paronychia (Table 2).

All cases of paronychia were controlled by the combination of antiseptic wound dressing, topical antibacterial ointment, oral antibiotics, topical and oral antifungal agents such as fluconazole or itraconazole.

DISCUSSION

Paronychia is one of the most common infections of the hand. Various environmental exposures, such as trauma, irritants, allergens, and excessive moisture, can be triggering factors for paronychia. Minor trauma enables bacterial inoculation of the nail and subsequent infection.

The most common causative pathogen of acute paronychia is *Staphylococcus aureus*, although *Streptococcus pyogenes*, *Pseudomonas pyocyanea*, and *Proteus vulgaris* can also cause paronychia^{2,3}. Further, *Candida albicans* may also be found in chronic paronychia lesions⁴.

The thumb and second finger are the most commonly involved sites of paronychia in fingers, and the great toe is the most common site in the toe in this study. Physical activities such as outdoor exercise and combat training likely increase the frequency of paronychia in military personnel. We identified 28 different types of aerobic bacteria in the paronychia lesions, the most frequently found being *Staphylococcus aureus*, *Staphylococcus epidermidis*, *Streptococcus pyogenes*, and *Pseudomonas aeruginosa*. As *Staphylococcus epidermidis* is well known to be a part of the skin's normal flora, we believe that of these four, *Staphylococcus epidermidis* is by far the least likely to be the causative bacteria for paronychia even though it was identified in 15 cases. Thus, *Staphylococcus aureus*, *Streptococcus pyogenes*, and *Pseudomonas aeruginosa* were likely the three most common types of paronychia-causing bacteria in our study.

Interestingly, *Staphylococcus aureus* was identified mostly in finger and toe paronychia lesions and *Pseudomonas aeruginosa* was recovered commonly from toe paronychia lesions. *Pseudomonas aeruginosa* needs moist and occlusive conditions for colonization and the development of a pseudomonal infection⁵. Moist, occlusive footwear and gloves can be potential causes of pseudomonal paronychia⁶. There is very good evidence for antagonism between *Pseudomonas aeruginosa* and *Staphylococcus aureus*. *Pseudomonas aeruginosa* can lyse *Staphylococcus aureus* and other gram-positive bacteria. In the case of *Staphylococcus aureus*, *Pseudomonas aeruginosa* can use the iron released by the lysis of *Staphylococcus aureus*

cells to support its own growth. Thus, bacterial antagonism may be related to the differential findings in terms of the types of bacteria cultured from fingers and toes^{7,8}.

There are a few studies about the bacteriology of paronychia in general population. *Staphylococcus aureus*, *Streptococcus pyogenes* and *Pseudomonas pyocyanea* is generally accepted as main pathogens in acute paronychia. Same pathogenic bacteria were detected in military personnel. Clinical symptoms and signs of paronychia were not distinct in military personnel compared with general population. However, Physical activities such as outdoor exercise and combat training may cause higher incidence of paronychia in military personnel.

The commonly used oral antibiotics for paronychia are amoxicillin-clavulanate, clindamycin, and trimethoprim-sulfamethoxazole¹. These antibiotics have a wide spectrum of activity and are effective against most pathogens isolated from paronychia lesions³. However, there have been no comparative trials that studied the effectiveness of these medications in paronychia. As this study as well as previous studies showed that the most common paronychia-causing organism was *Staphylococcus aureus*, the coverage of methicillin-resistant *Staphylococcus aureus* should be considered. In cases of paronychia in which methicillin-resistant *Staphylococcus aureus* is the infectious agent, clindamycin is a better option than amoxicillin-clavulanate, and oral trimethoprim-sulfamethoxazole can also be considered as a first-line agent⁹. If patients with chronic paronychia do not respond to topical therapy, a trial of systemic antifungal agents may be useful.

The major limitation of this study is that it only included aerobic bacteria. However, the common pathogens that cause paronychia are mainly aerobic organisms, and the results of this study are consistent with other studies on this topic^{1,10}.

In conclusion, *Staphylococcus aureus*, *Staphylo-*

coccus pyogenes, and *Pseudomonas aeruginosa* were the most common paronychia-causing bacteria in military personnel. The frequency of the types of paronychia-causing bacteria differed based on the site of the lesion, with finger paronychia being more likely to be associated with a *Staphylococcus aureus* infection, and *Pseudomonas aeruginosa* being found commonly in toe paronychia.

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